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Palynological Study of the Genus *Crepis* from Pakistan

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Abstract: Pollen morphology of four different species, *Crepis flexuosa, Crepis multicaulis, Crepis sancta* and *Crepis thomsonii,* belonging to genus *Crepis* of family Asteraceae were studied from Pakistan. Morphology of pollen grains of each of the species is based on 20 specimens selected at random. Proposed characters i.e., grain, shape of pollen grain, equatorial view, polar view, equatorial diameter (E), polar diameter (P), P / E ratio, length of colpus, exine surface, exine thickness, inter poral distance, inter spinal distance, inter spinal outline, length of spines and number of spines between colpi in each species were recorded for comparison. At species level, micromorphological differences and distribution of surface pattern, shape and size of pollen have been found to exist. The pollen grains are consistently echinate and trizonocolporate. Maximum equatorial diameter, polar diameter and colpus length was observed in *Crepis multicaulis* while in *Crepis flexuosa* spine length and exine thickness is found top be maximum. Inter poral distance is minimum in *Crepis flexuosa.* Inter spinal distance & P/E ratio is higher in *Crepis thomsonii.* This study demonstrates the potential of pollen studies in distinguishing some taxonomic groups in the Asteraceae.

Key words: Pollen morphology, *Crepis flexuosa, Crepis thomsonii*

Introduction

Pollen morphology of the *Lactuceae* (Cichorieae) is probably the more distinctive tribe in the family Asteraceae. The ligulate corolla, milky sap and echinolophate pollen form a unique combination of characters which it can be readily distinguished from the rest. This tribe consists of about 70 genera and 2300 species (Tomb, 1977). Stebbins (1953) proposed a natural system of classification for this tribe using geographical distribution, pollen morphology and chromosomal data in addition to traditional morphological characters. This method produced eight subtribes (I) Scolyminae, (ii) Cichorinae, (iii) Microseridinae, (iv) Stephanomeriinae, (v) Dendroseiidinae, (vi) Scorzonerinae, (vii) Leontodontinae and (viii) Crepidinae. Jeffrey (1966) revised Stebbin's classification recognizing the importance of micro characters like length of collector hairs on the style, shapes of hairs on stigmatic surfaces and pubescence on the corolla tube. He divided this tribe into five groups, eleven subgroups and 23 series.

Many workers regard pollen grains of *Lactuceae* as "Ligulifloraetype" (Moore and Webb, 1978) and contrast this with a Tubilifloraetype" for most of the reminder of the family Asteraceae. Boulos (1960) found that this genus was closely related to *Launaea.* Tomb *et al.* (1974) studied the pollen morphology of Stephanomeriinae and showed that pollen grains of most of the tribe were echinolophate or tricolporate with same, or almost the same, number and shape of lacunae and demonstrated strikingly different exine stratification in several genera. Skvarla *et al.* (1977) summarized much that was taken about pollen structure in the Asteraceae, where two major pollen types were categorized, namely, anthemoid and helianthoid, with various subtypes. Taxonomic, evolutionary and functional studies of the Asteraceae pollen grains on the basis of ultrastructure and sculpture were made by Bolick (1978), who noted two basic exine patterns: The caveate helianthoid and noncaveate Anthemoid. Ghazaly (1980) studied the pollen grains of 35 species of the subtribe Hypochoeridinae. Regarding the sub tribe Scorzonerinae with reference to its taxonomic significance, Blackmore (1982) recorded seven pollen types, which could be distinguished by a key constructed on the basis of the number and arrangement of the lacunae of the grains. Blackmore (1984) further dealt with pollen morphology of a large number of taxa of the tribe *Lactuceae* and recognized seven distinct pollen types, which were further subdivided into smaller groups on the basis of distinguishing characters.

According to Clark *et al.* (1980) pollen grains of the *Astereae* have been characterized as basically helianthoid, spherical or slightly flattened, tricolporate, and uniformly echinate, having internal foramina, with varying proportions of abnormalities in size and colpus number However, in conjunction with systematic studies of *Haplopappus* and related genera in the subtribe Solidaginae, we have found a few cases of significant variation in pollen size, spine length, and the number of spine rows between colpi. These characters indicate a potential for utilizing pollen characters in at least some systematic studies in the *Astereae.* According to Larson and Lewis (1961), interest in pollen morphology has increased as its useful application in systematics, paleoecology, paleobotany and inhalant allergy has been increasingly recognized. Pollen morphologists have responded to the need, created by this widespread application, for a more critical comparative analysis of pollen wall structure, and for an expansion in the number of recognized systematically and phylogenatically significant wall characteristics. In this response, successful use has been made of phase and ultraviolet microscopy in addition to more sophisticated light microscopy.

Pollen characters were used by Stebbins (1953) and monographic treatments since than have used them to some extent. Wodehouse (1965) characterized the basic exomorphology of *Lactuceae* pollen and described two basic pollen types (echinate and lophate). There have been several careful light microscopic studies of pollen since the wodehouse study (Pausinger, 1951; Saad, 1961). However, there has not been an in depth study of the tribe using modern electron microscopy techniques (SEM and TEM) until recently (Tomb *et al.*, 1974). These studies have shown that pollen of most of the tribe is echinolophate or tricolporate, with the same or almost the same numbers and shapes of lacunae, and demonstrated strikingly different exine stratification patterns in several genera.

Pollen characters have been careful at several levels in the systematics of the tribe. For example, in the Stephanomeriinae aperture shape supports the division of the subtribe into two phyletic lines, a division suggested by Stebbins (1953). In the ditypic genus *Glyptopleura* (Stephanomeriinae), pollen morphology (internal and external) of the two species is quite different (Tomb *et al.*, 1974). At the population level, using herbarium material, pollen characters have been used to map hybrids and polyploid (Tomb, 1970; Northington, 1971). Hybrids (as well as apomictic plants) usually produce a high frequency of aborted and irregular grains. Polyploid generally have larger pollen and are often tetracolpate.

Among the important contributions of these studies were the observations of variation in the fine structure of the ektexine, the size of the wall substance particles (5060 A), and the stratified nature of the exine. In both gymnosperms and angiosperms plants, an inner layer of the exine was observed to be laminated and less compact than the other layers. This layer was interepted as being a part of the endexine [homologous to the endonexine (Erdtman, 1952;1960)] and as having phylogenatic value. In the plants studied, pollen grains of the gymnosperms species were found to have a laminated layer considerably greater in thickness than that of any angiosperms plants studied. From this observation, a reduced laminated layer was considered phylogenetically advanced. In his electron microscopic study of the pollen wall in *Saintpaulia ionantha,* Ehrlich (1958) presented further evidence of a laminated layer between the intine and ektexine and also observed that this laminated layer made up the aperture membrane. In Ehrlich's study, this layer is interpreted as an independent wall layer, the mesine. Some pollen morphologists now recognize the pollen wall to be composed of ektexine, endexine, mesine & intine. The potential systematic value of the mesine or an analogous layer is made obvious as Rowley (1959) found no evidence of a mesine in the pollen wall in the Commelinaceae. The possibility that the lack of a mesine resulted from the techniques employed by Rowley (formalin fixation, OsO_4 staining and methacrylate embedding) is

ruled out as they were the same as those used by Ehrlich. Rowley also reported observing a mesine in pollen of dicotyledonous plants. The fine structure and wall stratification of fossilized pollen from the Eocene has also been analyzed by electron microscopy. Ehrlich and Halls's (1959) exciting study shows that fossilized pollen walls retain structural details, & indicates that the evolutionary development of the pollen wall may be subject to direct study. Recognizing the potential systematic and phylogenatic value of the pollen wall, especially the layer presently recognized as the mesine, a comparative study of *Parkinsonia aculeata* pollen wall was initiated. This species was chosen because, in an examination of the fine structure of the cytoplasm of this pollen, a mesinelike layer and an aperture membrane, more complex in fine structure than any previously reported, were observed.

In Pakistan, it is represented by 158 genera and 492 species (Stewart, 1972; Cope, 1982). Pollen grains of *Gramineae* also do not show much deviation from this contention and has long been recognized as remarkably uniform. Therefore, palynology plays a little role in the taxonomy of this family (Wodehouse, 1935; Rowley, 1960). However according to Wodehouse (1965) two characters viz., grain size and sexine pattern use of some significance. Firbras (1937) used the grain sizeas a basic character to separate wild and cultivated grasses. Rowley (1960) while studying the fine structure of some of the grass pollen used the arrangement of the spinules on the ektexine as a key character for delimiting various taxa.

Faegri and Iversen (1964) in their study of grass pollen, found two different types of sexine i.e., scabrate and areolate. Anderson and Bertelsen (1972) and Grant (1972) also used these types to distinguish various members of the tribe Triticeae, *Zea and Tripsacum,* respectively. Page (1978) in his Scanning Electron Microscopic survey of grass pollen further divided these two basic types on the basis of the proximity of granules, whether they are closely or widely spaced, while the fused type are differentiated on the basis of height of granules. Chaturvedi (1971) has reported 4 types of grains in Saccharum robustum viz., (I) normal monoporate grains (ii) double grains with two pores on either side of the dumbbell shaped pollen grains (iii) single diporate grains and (iv) double grains with single pore.

According to Memon (1984), the Scanning Electron Microscope has revealed micromorphological details of surface patterns of pollen grains, which are not resolved either by the transmission electron microscope or by an optical microscope, the sectional study of the exine can not be as accurately studied by the Scanning Electron Microscope as by the transmission electron microscope. The reveal advantage of the scanning electron microscope in the sectional study of exine in the sectional study of exine lies in the realm of middle magnitude structures in three dimensions. However, the optical microscope is very useful for basic study of pollen morphology, especially for studying the details of aperture. It was noted that the surface pattern of pollen grains was more completely analyzed by the scanning electron microscope than the optical microscope which exaggerates some features or does not reach the full depth of focus of exine sculpture.

The remarkable architecture of pollen exine is known to be distinctive for different texa and each species retains its specific statistic which can be characterized on the basis of pollen morphology (Memon, 1985). Erdtman (1963) segreted two South American genera *Abolboda* and *Orectanthe* from the family Xyridaceae and referred them to a special family Abolbodaceae solely on the basis of pollen morphological characters. The pollen morphology of family Proteaceae has revealed a wide spread heterogeneity and many genera including nearly all those with large number of species often lack unique combinations of pollen characters that could distinguish them from other genera of the family. Although some tribes and sub tribes with a small number of genera show homogeneity in their pollen morphology, nonetheless, they could not be separated from one another because invariable overlapping of surface pattern, shape and size of pollen grains was present throughout the family (Memon, 1984).

Zahur *et al.* (1975; 78) had provided a commendable quantity of basic and applied information in this line by describing the pollen grains of 486 angiosperm species. They also described the size range of pollen grains of Gramineae. Erdtman (1961) found uniporate pollen grains of *Hordeum vulgare* with 3μ diameter. Ashraf (1973) studied some medicinal plants palynologically. Wodehouse (1965) reported pollen grains of *Avena barbata* as an important cause of hay fever. Malik *et al.* (1964) studied pollen morphology of seventy five Pakistani medicinal plants. They observed that the pollen grains are of various shapes i.e., varying from spheroidal to prolate with polar or lateral germinal exits. They also reported different measurements of pollens. Elisens (1986) studied morphological variation among 12 new world genera in tribe Antirrhineae (Scrophulariaceae) with light and scanning electron microscopy. Pollens from 29 American species have mean polar diameter that range from 17 to 26 μm, have a tectate structure with perforate micro reticulate or reticulate surface pattern and are subspheroidal to proloate and trizonocolporate with fusiform or narrowly oblong, colpi that are free or occasionally fused at the poles.

The pollen characteristics of some medicinal plants was made by Malik *et al.* (1964). This seems to be first palynological contribution from Pakistan. Although Erdtman (1952) has very elaborately covered this neglected field yet regional pollen flora remained unexplored. Khan and Bhutta (1965) studied the pollen grains of honey. In a review paper Bhutta (1968) emphasized the need of this important field of science. Soon after Khan and Memon (1970) gave an account of the pollen morphology of certain Leguminous plants of Jamshoro, Sindh. Taking into account the applied form of Palynology it was found desirable to produce series of papers dealing with the fundamental Palynology of the plants growing in the Punjab. The fundamental palynology will certainly help the applied aspects. According to Ali (1988), in most of the plant groups in Angiosperms, at maturity, all the pollen grains are free from each other. As the prime function of the pollen grains is to provide the male gametes to the female counter part, in order to facilitate fertilization and ultimately the formation of the seed, such as category seems logical. However, it is also well known that in some plant groups, the pollen grains do not separate at maturity and remain associated together. The term pollen aggregate is used for all types of compound pollen grains and for various types of situations where pollen grains are dispersed in groups. He reviewed the evolutionary trends in pollen organization and discussed their adaptive significance. In the present investigation, the pollen morphology of the genus *Crepis*, all Pakistan, of the tribe *Lactuceae,* have been studied systematically. The present writers decided to contribute as much as possible and to start with different species of the genus Asteraceae. The present study was undertaken to evaluate the morphological differences in the pollen grains of family Asteraceae.

Materials and Methods

Pollen morphology: Pollen morphology of six taxa of Tribe *Lactuceae* of Asteraceae (Composite) from Pakistan was studied. The florets from mature capitula were extracted, either from the herbarium specimens of Quaid-I-Azam University; Islamabad or fresh polliniferous material collected from the wild was used in this research. Pollen grains were stained with 1 % safranine mixed in glycerin jelly. Glycerin jelly was prepared by dissolving 70 gm of gelatin in 42 ml distilled warm water in a beaker. The beaker was placed in another metalloid pot, containing boiling water. The gelatin was stirred for 12 hours. After this operation, 35ml of gelatin was added in it, followed by 1 gm of phenol crystals. This warm gelatin jelly was filtered filter paper; 1 % safari nine solution was poured in it in 1:1 ratio. The homogenized mixture was preserved in a vial and was used for staining the pollen grains.

Method of pollen drain study by light microscopy: Florets taken from herbarium specimens were kept in distilled water in petri dishes for about 24 hours so as to soften them and were then used, while fresh material was used directly. The florets were separated from capitula and were placed in a few drops of distilled water on a clean glass slide. With the help of dissecting needles, the florets were opened, the extra material was removed and the anthers were opened, the extra material was removed and the anthers were crushed to release pollen grains on the slide. Anther wall material was discarded, while excess of water was removed with filter paper. Pollens were stained with 1% safranine mixed in glycerin jelly. The slide was placed on a hot plate and when the stain had completely melted, any bubble formed was carefully removed. Cover slip was placed on the prepared pollen glycerin jelly mixture. When cooled, the glass slide was labeled and the cover slip edges were sealed with white transparent nail varnish. The prepared slides were studied under the light microscope. Eight slides of each Taxon were prepared and complete set is kept in the Plant Taxonomy Lab, Department of Biological Sciences, Quaid-I-Azam University, Islamabad. Their photographs were taken with Nikon Apaphot Microscope (LM).

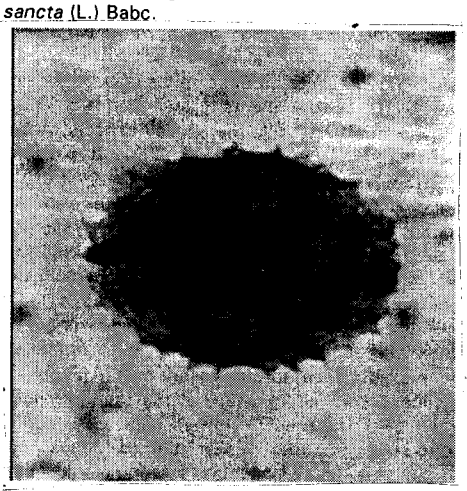
For the measurements of pollen grains, following characters were noted: grain, shape of pollen grain, equatorial view, polar view, equatorial

diameter (E), polar diameter (P), P/E ratio, length of colpus, Exine surface, exine thickness, inter poral distance, inter spinal distance, inter spinal outline,

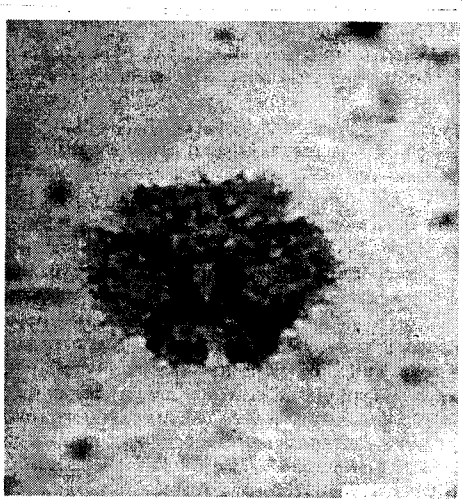
Results

Crepis sancta (L.) Babc. (Plate 1)
Grain: Trizonocolporate
Shape of pollen grain: Sub spheroidal
In Equatorial view: Sub spheroidal
In Polar view: Triangular
Exine surface: Echinate or Spinate
Inter spinal outline: V shaped

Plate I: Pollen light micrograph
Crepis sancta (L.) Babc.



A: Equatorial View,

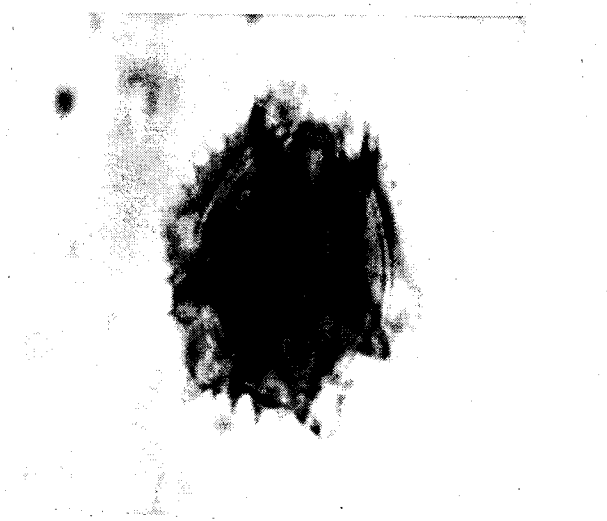


B: Polar View

Crepis flexuosa (DC.) B. & H. (Plate 11)
Grain: Trizonocolporate, Shape of pollen grain: Sub spheroidal
In Equatorial view: Sub spheroidal In Polar view: Triangular Exine surface: Echinate or Spinate
Inter spinal outline: V to U shaped

Plate II: Pollen light micrograph
Crepis flexuosa (DC.) B. & H

A: Equatorial View



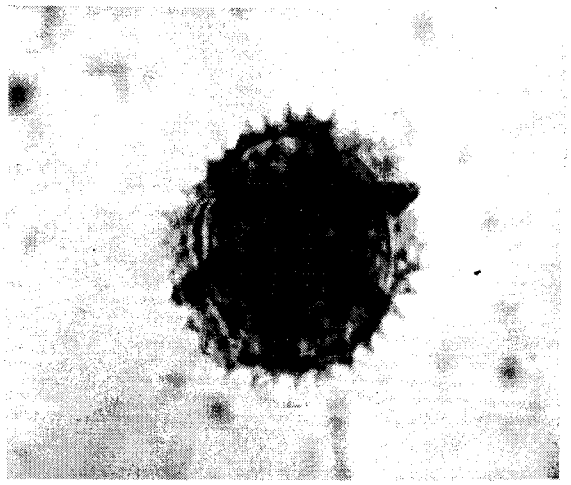
B: Polar View

Crepis multicaulis Ledeb. (Plate111)
Grain: Trizonocolporate
Shape of pollen grain: Spheroidal
In Equatorial view: spheroidal
In Polar view: Triangular (obtuse convex)
Exine surface: Echinate or Spinate
Inter spinal outline: V shaped

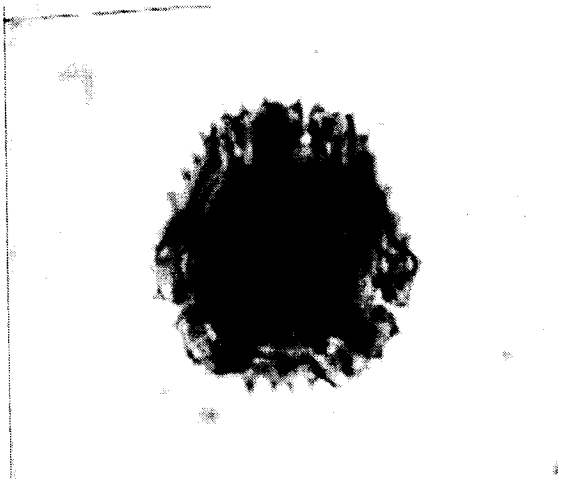
Discussion

Although the micromorphological study of pollen surface pattern, shape and size of Compositae/Asteraceae has demonstrated striking diagnostic features similar to the flora, chromosomal and vegetative characters of the family, these features show some inconsistencies with the taxonomic classification of the family into subfamilies, tribes, and sub tribes. However some genera retain individually unique surface pattern and some tribes and sub tribes with a small number of genera show homogeneity in their pollen surface pattern, though other characters such as shape and size range of pollen do not distinguish them from other members of the family. It is concluded that pollen morphology can not be solely used as the base of taxonomic classification of the family. However, if it is accepted that pollen morphology shows evolutionary sequences comparable to those in other organs, then it may need to be given as much weight as any other morphological character. On this assumption, in the pollen morphology of the species examined, some inconsistencies and alternative relationships have been suggested in correlation with the recent taxonomic classification

Plate III: Pollen light micrograph
Crepis multicaulis Ledeb.



A: Equatorial View



B: Polar View
Crepis thomsonii Babc. (Plate 1V)
Grain: Trizonocolporate
Shape of pollen grain: Sub spheroidal
In Equatorial view: Sub spheroidal
In Polar view: Triangular (obtuse convex)
Exine surface: Echinate or Spinate
Inter spinal outline: V shaped

Plate IV: Pollen light micrograph
Crepis thomsonii Babc.

A: Equatorial View

B: Polar View

proposed by Johnson and Briggs (1975). The general features of the Asteraceae, taken together are not repeated in other families. This gives Asteraceae (Compositae) a unique taxonomic status. To quote "Combined efforts of systematic, evolutionary and ecological studies are still necessary to help us understand the evolution of this fascinating family. *Lactuceae* is a tribe of Asteraceae, some plants in this tribe are of medicinal importance. Palynological studies of *Lactuceae* from Pakistan are carried out for the first time. The study of pollen morphology has assumed great significance in plant taxonomy and the advancements in microscopy have led to the effective use of new pollen morphological parameters for taxonomic purposes. This research was conducted to examine the value of pollen morphology in the taxonomy of *Lactuceae* and if the palynological characters are correlated to the morphological features, then they have great significance in taxonomy and may be considered as base for taxonomic decisions. For structure and pattern describing different characters, terminology followed is that of Erdtman (1969) and Nair and Lawrernce (1985). For clear understanding to the taxonomic status of the species following palynological characters like grain class, shape in equatorial and polar view, equatorial & polar diameter, P/E ratio, colpus length, exine surface, exine thickness, interporal distance, interspinal distance, interspinal outline, length of spine and number of spines b/w colpi were also considered. It is hoped that added information of pollen grains will help in taxonomic studies of *Crepis*.

The palynological characters not only provide the additional information but are also helpful to improve the systematic position of species with its respective family. It can be concluded that not only the general morphology but also the pollen morphology is of significance in species delimitation (Wodehouse, 1965). Pollen grains of Asteraceae may be resolved into two major groups i.e. lophate and nonlophate grains. The former ones characterize in *Sonchus, Lactuca* of *Lactuceae*. Among the members of *Lactuceae* the general pollen morphology is similar i.e., the different characters, terminology followed is that of Erdtman (1969) and Nair and Lawrance (1985). For clear understanding to the taxonomic status of the species following palynological characters like grain class, shape in equatorial and polar view, equatorial and polar diameter, P/E ratio, colpus length, exine surface, exine thickness, interporal distance, interspinal

Table 1: Minimum, maximum and average values of colpi length, exine thickness and interporal distance

	Length of colpi In microns			Exine thickness in microns			Interporal distance in microns		
Name of taxa	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average
Crepis flexuosa (DC.) B. & H	5	6	5.5	2.5	3.75	3.12	1.5	1.8	1.65
Crepis multicaulis Ledeb.	5	6.4	5.7	2	2.5	2.25	23.4	25	24.2
Crepis sancta (L.) Babc.	4.4	5	4.7	2.5	3.2	2.85	27.5	29.4	28.45
Crepis thomsonii Babc.	4.4	5	4.7	2.5	3.2	2.85	25	28	26.5

Table 2: Minimum, maximum and average values of polar and equatorial diameter

	Polar diameter in microns			Equatorial diameter in microns			P/E ratio in microns		
Name of taxa	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average
Crepis flexuosa (DC.) B. & H	23.5	25	24.25	25	27	26	0.93	0.94	0.93
Crepis multicaulis Ledeb.	35	40	37.5	37.5	42.5	40	0.93	0.94	0.93
Crepis sancta (L.) Babc.	32.5	33.5	33	32.5	34.4	33.45	0.97	1	0.99
Crepis thomsonii Babc.	32.5	37.5	35	31.4	35	33.2	1.07	1.03	1.05

Table 3: Minimum, maximum and average values of inter spinal distance, spine length and spine rows between Colpi

	Inter spinal distance in microns			Length of spines in microns			Number of spine rows b/w Colpi in microns
Name of taxa	Minimum	Maximum	Average	Minimum	Maximum	Average	
Crepis flexuosa (DC.) B. & H	2.5	2.9	2.7	2.5	3.75	3.12	6
Crepis multicaulis Ledeb.	1.25	2.5	1.87	1.5	2	1.75	6
Crepis sancta (L.) Babc.	3.75	4	3.87	2.5	3.1	2.8	6
Crepis thomsonii Babc.	2.5	5	3.75	2	2.5	2.25	8

distance, interspinal outline, length of spine and number of spines b/w colpi were also considered. It is hoped that added information of pollen grains will help in taxonomic studies of *Crepis*.

The palynological characters not only provide the additional information but are also helpful to improve the systematic position of species with its respective family. It can be concluded that not only the general morphology but also the pollen morphology is of significance in species delimitation (Wodehouse, 1935). Pollen grains of Asteraceae may be resolved into two major groups i.e., lophate and nonlophate grains. The former ones characterize in *Sonchus, Lactuca* of *Lactuceae*. Among the members of *Lactuceae* the general pollen morphology is similar i.e. the exine surface is echinate (spinate) or echinate (spinulate), the pollen grain is trizonocolporate but in some species tetrazonocolporate. In the present investigation the genus *Crepis* characteristic pollen grains were observed. In the genus *Crepis*, all the pollen grains were trizonocolporate. The most common pollen grain shape in equatorial view was sub spheroidal while in polar view, the shape observed triangular (obtuse convex). In *Crepis*, equatorial diameter the size ranged between 25 μm (minimum) and 27 μm (maximum) (Table 2). In equatorial diameter *Crepis flexuosa* has minimum pollen grain sized 25 μm while *Crepis multicaulis* have maximum pollen grain size 42.5 μmg. in polar diameter the size varies between 23.535 μm (minimum) and 25.40 μm (maximum). *Crepis flexuosa* has minimum polar diameter 23.5 μm and *Crepis multicaulis* has maximum polar diameter 4.0 μm (Table 1). Maximum value of colpi length was found in *Crepis multicaulis* 6.4 μm while minimum value was observed in *Crepis thomsonii* & *Crepis sancta* 4.4 μm. Spines were present in all the species so exine surface is echinate or spinate. In this research project, some more morphological parameters were considered for their application in plant taxonomy, which were found to be useful. In *Crepis multicaulis* exine thickness is 2 μm, which is minimum, while in *Crepis flexuosa* 3.75 μm maximum exine thickness were observed (Table 3). Minimum value of interporal distance were found in *Crepis flexuosa* 1.5 μm while maximum value of interporal distance were found in *Crepis sancta* 29.4 μm. The maximum interspinal distance were found in *Crepis thomsonii* 5 μm while minimum in *Crepis multicaulis* 1.25 μm. Interspinal outline is V shaped in all the species of *Crepis* but V to U shaped in *Crepis flexuosa*. Spine length is found to be maximum in *Crepis flexuosa* 3.75 μm while minimum in *Crepis multicaulis* 1.5 μm. Number of spine rows b/w colpi were six in *Crepis sancta, Crepis flexuosa, Crepis multicaulis* while eight rows were observed in *Crepis thomsonii*. The pollen grains of *Crepis* are very unique in structure that *Crepis multicaulis* have maximum equatorial diameter, polar diameter & colpi length while *Crepis flexuosa* have maximum spine length and exine thickness. *Crepis sancta* have maximum interporal distance while characteristically minimum interporal distance were observed in *Crepis flexuosa*. In *Crepis thomsonii* maximum value of interspinal distance and P/E ratio were observed.

Light microscopic observations could not clearly indicate the exine sculpturing. Bolick (1978) suggested that Scanning Electron Microscopic (SEM) studies should be carried out for obtaining many characters of great taxonomic importance. Not only the general morphology but also pollen morphology is of significance in species delimitation and pollen characters are correlated with morphological features (Stix, 1960). Palynology can play a very important role in solving the taxonomic problems if the pollen characters are correlated with morphological characters to become a qualitative character. It is recommended that pollen grains of the plants should be studied pharmacognistically to determine their importance in medicine, in this way medicinal plants can be explored from Pakistan. According to Clark *et al.* (1980) that the pollen morphology of some genera in the *Astereae* can be useful in supporting taxonomic suggestions.

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